horizontal axis. Another system employs a television-type camera that electronically scans the scene. On both types of stationary scanners, the radiation transmitted through an IR filter is focused onto a detector that converts the radiation into an electrical signal. The resulting image is displayed in real time on a small television-type screen and may also be recorded for later analysis.

One use of stationary scanners is to record the pattern of heat radiating from the human body. This medical application is called thermography; the images are called thermograms. Tumors and impaired blood circulation are physiological disorders that are detectable on thermograms. Stationary scanners are also used to monitor industrial facilities for hot spots that may indicate potential problems. Anomalous hot spots on the exterior of industrial furnaces may be areas where the fire brick lining has eroded and failure is imminent. In electrical transmission facilities, faulty transformers and insulators have been detected by their high radiant temperatures. Railroads use IR scanners to detect overheated wheel bearings in moving trains.

**CHARACTERISTICS OF IR IMAGES**

On most thermal IR images, the brightest tones represent the warmest radiant temperatures, and the darkest tones represent the coolest ones (Figure 5-9). The apparent similarity of IR images to black-and-white aerial photographs results from the fact that both are displayed as gray-scale variations on film. In photography, film acts as the medium for detecting, recording, and displaying reflected energy in the 0.4-to-0.9-μm wavelength region. For thermal IR images, however, a semiconductor device detects the energy, and film serves only as a medium to display radiant temperatures.

**Effects of Weather on Images**

Clouds typically show the patchy warm-and-cool pattern illustrated in Figure 5-9A, where the dark signatures are relatively cool and the bright signatures are relatively warm. Scattered rain showers produce a pattern of streaks parallel with the scan lines on the image. A heavy overcast layer reduces thermal contrasts between terrain objects because of reradiation of energy between the terrain and cloud layer. Images may be acquired by flying below the cloud layer, but the resulting thermal contrast is relatively low.

Wind produces characteristic patterns of smears and streaks on images. Wind smears (Figure 5-9B) are parallel curved lines of alternating lighter and darker signatures that may extend over wide expanses of the image. Wind streaks occur downwind from obstructions on flat terrain and typically appear as the warm (bright) patterns shown in Figure 5-9C. In this example, the wind is blowing from right to left across obstructions, which are clumps of trees with warm signatures. Wind velocity is lower downwind from obstructions, which reduces the cooling effect; thus terrain in the sheltered areas is warmer than terrain exposed to the wind. Wind smears and streaks may be avoided by acquiring images only on calm nights, but, in many regions, surface winds persist for much of the year and their effects must be endured. Interpreters must be alert to avoid confusing wind-caused signatures with terrain features.

Figure 5-9 Effects of weather on thermal IR images.